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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/899,189	07/06/2001	Harald Seidl	P21161	2689

7055 7590 05/19/2004

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EXAMINER

PHAM, HOAI V

ART UNIT PAPER NUMBER

2814

DATE MAILED: 05/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. 09/899,189	Applicant(s) SEIDL ET AL.	
	Examiner Hoai V Pham	Art Unit 2814	<i>AW</i>

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 25 February 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-14 and 17-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-13 and 17-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 14 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78:
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

### Attachment(s)

- |                                                                                              |                                                                             |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                             | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____  |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)         | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Specification***

1. The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

### **Arrangement of the Specification**

2. As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

- (a) TITLE OF THE INVENTION.
- (b) CROSS-REFERENCE TO RELATED APPLICATIONS.
- (c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
- (d) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC (See 37 CFR 1.52(e)(5) and MPEP 608.05. Computer program listings (37 CFR 1.96(c)), "Sequence Listings" (37 CFR 1.821(c)), and tables having more than 50 pages of text are permitted to be submitted on compact discs.) or  
REFERENCE TO A "MICROFICHE APPENDIX" (See MPEP § 608.05(a). "Microfiche Appendices" were accepted by the Office until March 1, 2001.)
- (e) BACKGROUND OF THE INVENTION.
  - (1) Field of the Invention.
  - (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (f) BRIEF SUMMARY OF THE INVENTION.
- (g) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
- (h) DETAILED DESCRIPTION OF THE INVENTION.
- (i) CLAIM OR CLAIMS (commencing on a separate sheet).
- (j) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
- (k) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

### Content of Specification

- (a) Title of the Invention: See 37 CFR 1.72(a) and MPEP § 606. The title of the invention should be placed at the top of the first page of the specification unless the title is provided in an application data sheet. The title of the invention should be brief but technically accurate and descriptive, preferably from two to seven words may not contain more than 500 characters.
- (b) Cross-References to Related Applications: See 37 CFR 1.78 and MPEP § 201.11.
- (c) Statement Regarding Federally Sponsored Research and Development: See MPEP § 310.
- (d) Incorporation-By-Reference Of Material Submitted On a Compact Disc: The specification is required to include an incorporation-by-reference of electronic documents that are to become part of the permanent United States Patent and Trademark Office records in the file of a patent application. See 37 CFR 1.52(e) and MPEP § 608.05. Computer program listings (37 CFR 1.96(c)), "Sequence Listings" (37 CFR 1.821(c)), and tables having more than 50 pages of text were permitted as electronic documents on compact discs beginning on September 8, 2000.

Or alternatively, Reference to a "Microfiche Appendix": See MPEP § 608.05(a). "Microfiche Appendices" were accepted by the Office until March 1, 2001.

- (e) Background of the Invention: See MPEP § 608.01(c). The specification should set forth the Background of the Invention in two parts:
  - (1) Field of the Invention: A statement of the field of art to which the invention pertains. This statement may include a paraphrasing of the applicable U.S. patent classification definitions of the subject matter of the claimed invention. This item may also be titled "Technical Field."
  - (2) Description of the Related Art including information disclosed under 37 CFR 1.97 and 37 CFR 1.98: A description of the related art known to the applicant and including, if applicable, references to specific related art and problems involved in the prior art which are solved by the applicant's invention. This item may also be titled "Background Art."

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- (f) Brief Summary of the Invention: See MPEP § 608.01(d). A brief summary or general statement of the invention as set forth in 37 CFR 1.73. The summary is separate and distinct from the abstract and is directed toward the invention rather than the disclosure as a whole. The summary may point out the advantages of the invention or how it solves problems previously existent in the prior art (and preferably indicated in the Background of the Invention). In chemical cases it should point out in general terms the utility of the invention. If possible, the nature and gist of the invention or the inventive concept should be set forth. Objects of the invention should be treated briefly and only to the extent that they contribute to an understanding of the invention.
- (g) Brief Description of the Several Views of the Drawing(s): See MPEP § 608.01(f). A reference to and brief description of the drawing(s) as set forth in 37 CFR 1.74.
- (h) Detailed Description of the Invention: See MPEP § 608.01(g). A description of the preferred embodiment(s) of the invention as required in 37 CFR 1.71. The description should be as short and specific as is necessary to describe the invention adequately and accurately. Where elements or groups of elements, compounds, and processes, which are conventional and generally widely known in the field of the invention described and their exact nature or type is not necessary for an understanding and use of the invention by a person skilled in the art, they should not be described in detail. However, where particularly complicated subject matter is involved or where the elements, compounds, or processes may not be commonly or widely known in the field, the specification should refer to another patent or readily available publication which adequately describes the subject matter.
- (i) Claim or Claims: See 37 CFR 1.75 and MPEP § 608.01(m). The claim or claims must commence on separate sheet (37 CFR 1.52(b)). Where a claim sets forth a plurality of elements or steps, each element or step of the claim should be separated by a line indentation. There may be plural indentations to further segregate subcombinations or related steps. See 37 CFR 1.75 and MPEP § 608.01(i)-(p).
- (j) Abstract of the Disclosure: See MPEP § 608.01(f). A brief narrative of the disclosure as a whole in a single paragraph of 150 words or less commencing on a separate sheet following the claims. In an international application which has entered the national stage (37 CFR 1.491(b)), the applicant need not submit an abstract commencing on a separate sheet if an abstract was published with the international application under PCT Article 21. The abstract that appears on the cover page of the pamphlet published by the International Bureau (IB) of the World Intellectual

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Property Organization (WIPO) is the abstract that will be used by the USPTO. See MPEP § 1893.03(e).

- (k) Sequence Listing. See 37 CFR 1.821-1.825 and MPEP §§ 2421-2431. The requirement for a sequence listing applies to all sequences disclosed in a given application, whether the sequences are claimed or not. See MPEP § 2421.02.

### ***Claim Objections***

3. Claim 14 is objected to because of the following informalities:

Lines 8, 12-14, and 16, "first metal electrode" and "second metal electrode" should be changed to --first electrode" and "second electrode"-- because arsenic-doped polycrystalline silicon or polysilicon-germanium is not a metal.

Lines 8-11, "providing a first electrode layer on the dielectric layer inside the trench as a second conducting capacitor plate; filling a conducting filling material into the trench and etching back the conducting filling material to the upper side of the first conducting capacitor plate;" should be changed to --providing a first electrode layer on the dielectric layer inside the trench as a second conducting capacitor plate by filling a conducting filling material into the trench and etching back the conducting filling material to the upper side of the first conducting capacitor plate-- for clarifying the scope of the claim.

Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claim 14 is rejected under 35 U.S.C. 102(e) as being anticipated by Wei et al. [U.S. Pat. 6,251,722] previously applied.

Wei et al. (figs. 3-15, cols. 3-4) discloses a method for producing a trench capacitor, for use in a semiconductor memory cell, the method comprising:

forming a trench (32) in a semiconductor substrate (31) (fig. 4, col. 3, lines 27-28);

providing a first conducting capacitor plate (33) in the trench (fig. 6);

providing a dielectric layer (351) as a capacitor dielectric on the first conducting capacitor plate (fig. 10);

providing a first electrode layer (361) on the dielectric layer (351) inside the trench as a second conducting capacitor plate by filling a conducting filling material (361) into the trench and etching back the conducting filling material to the upper side of the first conducting capacitor plate (fig. 11, col. 4, lines 4-8);

forming an isolation collar (352) in an upper region of the trench (fig. 14);

providing a second electrode layer (362) into the upper region of the trench by such that the second electrode layer is in electrical connection with the first electrode layer (fig. 15, col. 4, lines 18-21),

wherein at least one of the dielectric layer, the first conducting capacitor plate, the first electrode layer and the second electrode layer is applied by CVD method (see col. 3, lines 64-67 and col. 4, lines 4-24).

### ***Response to Arguments***

6. Applicant's arguments filed on February 25, 2004 have been fully considered but they are not persuasive.

Applicant argues that Wei does not disclose or suggest a first and a second electrodes are metal electrode layer.

Applicant's argument is not persuasive because in the Applicant's specification, pages 10-11, the first electrode (80) is made of arsenic-doped polycrystalline silicon or polysilicon-germanium and the second electrode (80') is made of polysilicon doped with arsenic. Germanium is a semiconductor material (see S. Wolf and R.N. Tauber, Silicon Processing, volume 1, as attachment).

### ***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoai V Pham whose telephone number is 571-272-1715. The examiner can normally be reached on 9:30A.M. - 8:00P.M..



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8. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

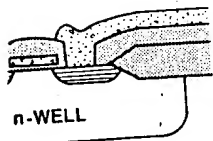


Hoai Pham  
May 4, 2004

# SILICON :

## SINGLE CRYSTAL GROWTH

### and WAFER PREPARATION



Silicon (Si) is presently the most important semiconductor for the electronics industry, with VLSI technology being based almost entirely on silicon. The name *silicon* comes from the Latin *silex* or *silicis* meaning flint. Second in abundance only to oxygen, silicon comprises 25.7% of the earth's crust. The parameter values of some of the most useful properties of silicon<sup>1</sup> are given in Appendix 1.

Solid-state electronics was launched with the invention of the bipolar transistor by Bardeen, Brattain, and Shockley in 1947<sup>2</sup>. Germanium (Ge) was the original semiconductor material used to fabricate diodes and transistors. The narrow bandgap of Ge (0.66 eV), however, causes reverse-biased p-n junctions in Ge to exhibit relatively large leakage currents. This limits Ge device operation to temperatures below about 100°C. In addition, integrated circuit planar processing requires the capability of fabricating a passivation layer on the semiconductor surface. Germanium oxide (GeO<sub>2</sub>) could act as such a layer but it is difficult to form, is water soluble, and dissociates at 800°C. These limitations make Ge an inferior material for the fabrication of integrated circuits, compared to silicon. The larger bandgap of silicon (1.1 eV) results in smaller leakage currents and thereby allows silicon devices to be built with maximum operating temperature of about 150°C. The oxide of silicon, SiO<sub>2</sub>, is also easy to form and is chemically very stable. Finally electronic grade silicon is about one tenth as costly as germanium. As a result, Si has almost completely replaced Ge for fabricating microelectronic components.

In this chapter we consider the subject of *single-crystal silicon starting material*. We first show how raw material is processed to obtain electronic grade polysilicon. Then we examine the Czochralski and float-zone methods of growing single crystal silicon from such polysilicon. Next, the technology for forming the *silicon wafers* from single crystal ingots is covered. Finally, a discussion of the material properties that such silicon wafers must possess in order to be suitable for VLSI (and ULSI) fabrication is presented. In Chap. 2, we cover the crystalline defects that occur in silicon, and techniques for suppressing their formation.

## TERMINOLOGY OF CRYSTAL STRUCTURE

Solid matter exists in crystalline and amorphous forms. In crystalline solids, the atoms which make up the solid are spatially arranged in a periodic fashion. If the periodic arrangement exists throughout the entire solid, the substance is defined as being formed of a *single crystal*. If

en-mask process sequence.

the layout information is stored on a computer. manufacturing steps that occur (Fig. 3). That is, the first of the procedures utilized to of masks or reticles. All of is, introducing dopants, and res) are also subjects of this ture of Si wafers (i.e. the irect supporting technologies sented. In Volume 2 of this g process simulation, process *Manufacturing Technology*.

esley, Reading, MA. 1980.  
k, 1983.  
esign, Prentice-Hall, 1986.